

REMARKS/ARGUMENTS

Claim 4 is the independent claim pending herein. Described in Claim 4 is a method for forming a silicon-cobalt film which comprises forming a coating film of a silicon-cobalt film-forming composition comprising a silicon compound and a cobalt compound on a substrate, and then subjecting the film to a heat treatment and/or a light treatment to form a silicon-cobalt film having a Co/Si atomic ratio of 0.1 to 10. The Examiner, in maintaining the rejection of the claims over Ikai, insists that the final heat-treated film of Ikai contains catalyst, which can be cobalt. This is not correct for the following reasons, and thus constitutes reversible error.

It is uncontroverted that Ikai discloses a method wherein a hydrosilane monomer is subjected to dehydrogenative condensation in the presence of a catalyst to provide a condensate, followed by thermal decomposition of the condensate to provide a final material:

According to the invention, a method is provided for producing a semiconducting material. The method comprises subjecting a hydrosilane monomer to dehydrogenative condensation followed by thermal decomposition. The hydrosilane monomer is one or more of, for example, a hydromonosilane, hydrodisilane and hydrotrisilane. (col. 1, lines 35-40)

The first step, the making of the condensate, is described as follows in the reference:

The dehydrogenative condensation occurs upon contacting one or more of the above hydrosilane compounds with a catalyst comprising at least one metal or metal compound of Groups 3B, 4B and 8 of the Periodic Table, in an amount of 0.01-10 moles of catalyst per 100 moles of the hydrosilane monomer, under conditions including a temperature of 0 °C-400°C and a pressure of 1 mmHg to 200 kg/cm² for a time of 5 minutes to 72 hours, to provide a condensate. (col. 2, lines 15-22)¹

¹ Cobalt is identified as a Group 8 metal at col. 8, line 49 of Ikai. However, none of the Examples use cobalt.

This, of course, is not the end of the story. The second step in Ikai is the thermal decomposition of the intermediate condensate to provide a final semiconducting material:

The thermal decomposition results upon exposing the condensate to a temperature of 100°C-2,000°C in an atmosphere which is either an inert gas, a reducing atmosphere or a vacuum of 10^{-5} - 10^{-4} pa, to provide a semiconducting material. (col. 2, lines 23-27)

The Examiner has maintained his original position that the cobalt used in the initial preparation of the intermediate condensate is present in the condensate during thermal decomposition, and thus is present in the final film produced in Ikai. However, this position is wholly unsupported by the reference itself, and it ignores the very specific and explicit teachings in the reference regarding the purification of the intermediate condensate prior to thermal decomposition. As there is no support in the record for this position, it should be reversed.

For example, at col. 15, lines 30-34 Ikai directs purification of the intermediate condensate as follows:

The resultant condensate may be treated with acids such as hydrochloric acid, sulfuric acid, acetic acid, trifluoro acetate and benzenesulfonic acid, or alternatively refined with use of Florisil (tradename) or by re-precipitation. These processes may also be combined.

Importantly, and consistent with the general practice in the art, all of the 15 Examples in Ikai use one of these purification methods, thereby removing metal catalyst prior to thermal decomposition. Example 1 at col. 17, lines 6-25 is illustrative:

EXAMPLE 1

166 mg (0.437 mmol) of Cp^2HfCl_2 and 369 mg (0.784 mmol) of $(\text{Me}^3\text{Si})^3\text{SiLi-THF}^3$ were placed into a 100 ml glass flask equipped with magnetic stirrer, followed by addition of 5.0 ml (40 mmol) of PhSi_3 . Immediately thereafter, there was vigorous gas formation,

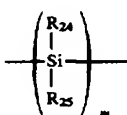
whereupon the reaction product discolored to yellowish brown. The gas generation continued vigorously for about 10 minutes and then grew mild. The admixture was stirred first at 100°C for one hour and then at 200°C for two hours, whereupon the reaction product was dissolved in 500 ml toluene, passed through a column containing 55 g of Florisil and stripped of toluene to give a yellowish particulate condensate in a yield of 96% by weight in terms of PhSiH_3 .

The condensate was dissolved in toluene, cast over a sheet of quartz glass and heated at 700°C for one hour in an argon atmosphere. There was obtained a thin dark brown film which exhibited a conducting of 10^{-3} s/cm.

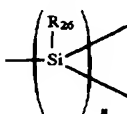
In Example 1 of Ikai, by passing the condensate through the Florisil column, catalyst is removed and a dark brown film is obtained after thermal degradation. In contrast, and as noted at, e.g., present specification page 19, the present invention silicon-cobalt films having a Co/Si atomic ratio of 0.1 to 10 show a *metallic* quality and can be used for, e.g., wiring.

Additionally, the reference intermediate condensate is described in Ikai as containing the following repeating units:

The condensate obtained in accordance with the invention usually contains repeating units of the formulae

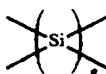


(i)



(ii)

and



(iii)

wherein R_{24} , R_{25} and R_{26} are identical or different, and each include hydrogen $\text{C}_1\text{--C}_{12}$ alkyl, cyclosilyl and halogenated alkyl groups, $\text{C}_7\text{--C}_{12}$ aralkyl and halogenated aralkyl groups, $\text{C}_6\text{--C}_{12}$ aryl groups and the silyl groups (formula I), and may be crosslinked within and between the repeating unit structures. R_{24} , R_{25} and R_{26} are preferably sec-alkyl or tert-alkyl groups, more preferably tert-alkyl groups. The value for n/m is usually 0–10, preferably 0–5, and o/n is usually 0–10, preferably 0–5.

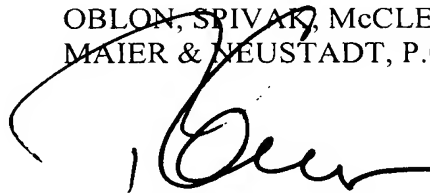
which repeat units do not and cannot include cobalt in the molecular structure of the intermediate condensate polymer. See col. 15, lines 39ff.

Clearly, then, and in view of the totality of the evidence herein, the condensate described in Ikai does not contain cobalt and, thus, the final product of thermal decomposition in Ikai necessarily lacks cobalt. As such, Applicants' present method is not disclosed or suggested. Tanaka and Yamazaki, cited as secondary references in rejecting Claims 7-8 and 20 do not address the fundamental differences between Ikai and the present invention, and thus cannot repair the defects of the primary reference

Accordingly, and in view of the above amendments and remarks, Applicants respectfully submit that the present application is now in condition for allowance, and early notification to this effect is respectfully requested.

Respectfully submitted,

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